Learning is not attained by chance; it must be sought for with ardor and attended to with diligence. Abigail Adams

Introduction

Classroom@Sea was a project of opportunity. It was an opportunity that arose out of the new satellite technologies placed on board several National Oceanic and Atmospheric Administration's (NOAA) research ships that were dedicated to improve communication and the transfer of scientific data. It was also an opportunity for me to blend my study of educational technologies at the University of Washington with my work in resource management and education at NOAA.

Classroom@Sea became an attempt to use new technologies to connect students and teachers in the classroom with real life scientists aboard NOAA research vessels so they could investigate the ocean together. Classroom@Sea also demonstrated how the practice of instructional design could be blended together with perspectives of sociocultural learning to create a web-based community composed of two very different and distant groups of people.

The dynamic nature of using satellite technologies to connect the people living and working aboard NOAA's ships with students in a classroom proved to be an interesting venture for three particular reasons.

1. **The institutions proved to have challenges and opportunities that significantly impacted participants' involvement in the learning community.**
2. **Participants' own perspectives of teaching and learning influenced how they communicated and engaged in activities.**
3. **The affordances and constraints of the technologies contributed to and impeded participants' involvement in the learning community.**

The tasks of supporting, observing and documenting the experiences of such dynamic institutions, participants, and technologies resulted in an interesting story, an ethnography, that contributes to what is known about on-line learning communities. The purpose of this document is to share what was learned about the institutions, participants and technologies that were part of Classroom@Sea.

Organization of this Document

This document represents a synthesis of the information gathered and analyzed for my dissertation entitled *Learning Communities and On-line Technologies: the Classroom@Sea Experience* (Malarney, 2000). Therefore, included in this document are only brief descriptions of the project and corresponding research, and a summary of the findings. For a complete background, analysis and discussion please refer to the original document.

The purpose of this document is to share the results of an ethnographic study that focused on the Classroom@Sea experience. The document has been divided into 6 sections. These sections are:

- Background of Classroom@Sea
- Educational Foundations of Classroom@Sea
- The Classroom@Sea Research Project
- Classroom@Sea Activities
- Classroom@Sea Findings
- Re-envisioning Classroom@Sea

Each section provides a different level of detail, and/or a different perspective of the Classroom@Sea experience. Sections can be read as a continuous unit in which one section builds on the other, or independent of one another, depending on the interest of the reader. It is, however, recommended that the reader begin with the section – Background of Classroom@Sea - before progressing to other sections of the document.

Background of Classroom@Sea

Classroom@Sea was a cooperative venture launched by the National Oceanic and Atmospheric Administration (NOAA) and the University of Washington. Classroom@Sea began in 1997 through funding from NOAA's Office of High Performance Computing and Communications and the National Marine Sanctuary Program, as an expansion of the NOAA Corps Internet@Sea initiative. It continued through support from the College of Education, and through money received from the Royalty Research Fund (both part of the University of Washington).

Figure 1. Students aboard the NOAA S MCARTHUR during Phase 1 of Classroom@Sea.

The Classroom@Sea project was conducted in two Phases. Phase I, launched in the fall of 1997, focused on the construction of the Classroom@Sea web site. To accomplish this, I traveled aboard the NOAA ships MCARTHUR in Monterey Bay, California and MILLER FREEMAN in the Bering Sea, Alaska conducting interviews and documenting activities to better understand the scope and nature of ocean science, and determining the necessary attributes for a Classroom@Sea web site. Similarly, I spent several weeks with 10th graders at a Pacific Northwest High School to determine their understanding of ocean science, and their skills and needs for utilizing the web as a tool for teaching and learning. A significant outcome of Phase I was recognizing that teaching and learning about ocean science is much more complex than traditional stereotypes of laboratory science.

Three themes emerged to describe ocean science and provide structure to the Classroom@Sea web site. These are:

1. *Scientific investigations* – the actual science of ocean science.
2. *Ship operations and navigation* – maintaining and operating a safe and functional research platform.
3. *Life at Sea.* – living aboard ships for days and weeks at a time doing and supporting the activities of ocean science.

With the help of a team of graphics designers and a webmaster, a prototype web site was posted in June 1998 (http://classroomatsea.noaa.gov). The prototype is displayed in Figure 2, and has been guided by the principles developed by the University of Michigan (Lyons, Hoffman, Krajcik, & Soloway, 1997).

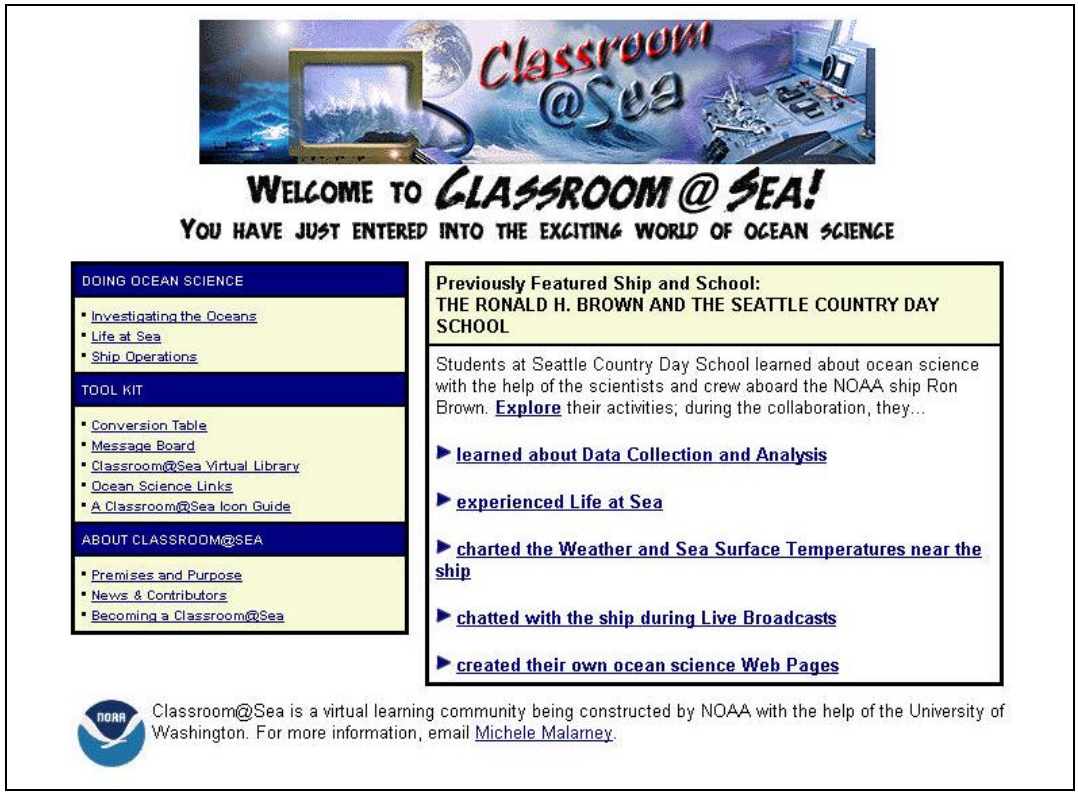

Figure 2. Home Page for the Classroom@Sea web site.

Phase II began in July 1998, and involved the actual connection of people between ship and shore. During this Phase we worked with people aboard the NOAA research ship RONALD H. BROWN (RON BROWN) and 7th grade students at The Ridgemont Academy (the Academy). The RON BROWN was used for this phase of the project because of the technological capabilities on board. The Ridgemont Academy was involved because of changes in teachers and students with the previous school.

Institutions Involved

Three institutions were involved in the Classroom@Sea project. These institutions were: NOAA, the Ridgemont Academy, and the University of Washington.

The National Oceanic and Atmospheric Administration

NOAA is a federal agency having a multitude of responsibilities associated with investigating, protecting, and managing ocean and atmospheric resources. Its mission is

> to describe and predict changes in the Earth's environment and conserve and manage wisely the Nation's coastal and marine resources to ensure sustainable economic opportunities. (NOAA, 1998, p.1)

While NOAA has responsibilities for conserving and managing ocean and coastal resources, it has no direct mandate for providing educational services to meet those needs. NOAA does have an Outreach Unit within the Office of Public and Constituent Affairs that provides educational resources for teachers and students, and for public constituents. In addition, there are several programs within the agency that strongly support educational efforts. These are NOAA's Globe Program, NOAA's National Marine Sanctuary Program, and the Teacher at Sea Program. Other groups within NOAA provide educational services on a more informal basis. The Office of Marine and Aviation Operations (formerly known as the Office of NOAA Corps Operations) sponsors the Teacher at Sea Program. The purpose of this program is to include teachers on board the research vessels as part of the scientific complement during cruises throughout the summer and school year. Teachers are in turn asked to take what they've learned aboard the vessels and incorporate it into their classroom

curriculum. Classroom@Sea tried to build on this program because of the direct connection with NOAA's research vessels.

During the time Classroom@Sea was being developed in 1998, another NOAA Ship, the TOWNSEND CROMWELL had initiated a similar program to answer student questions and transmit information and images to a small number of schools in Hawaii. This program was called School Connection. According to the CROMWELL,

> The web site utilizes the Internet and Inmarsat (satellite communications), to provide twice weekly communication between students and the research ship. Through this web site, students can follow the vessel's daily operations through regularly posted pictures and write-ups. (http://atsea.nmfs.hawaii.edu/home.htm)

The School Connection program was initiated by people on board the ship, working in partnership with teachers from Hawaii.

Classroom@Sea had some similarities with School Connection in that both programs intended to build connections between the ship and the classroom. Both used the web as an interface to do that and encouraged student generated questions as a basis for communication. An important difference to note was that Classroom@Sea intended to build a sense of community. Participants not only communicated with one another, but also participated in common activities in order to build relationships within the community. Classroom@Sea intended to focus on building more long-term relationships between the students and the participants on board the ship, rather than anonymous questions and answers.

At the time of this study, the NOAA Ship RONALD H. BROWN (RON BROWN) was one of the Nation's most technologically advanced research vessels. The RON BROWN had high-speed Inmarsat satellite technologies capable of transmitting live video broadcasts from ship to shore. It was equipped to support a variety of oceanographic, biological, and atmospheric research programs.

During Classroom@Sea the ship traveled from Victoria, British Columbia to the equatorial Pacific Ocean working on the TAO buoy array in support of the El Nino program. The ship then cruised through the Panama Canal, transiting back to its home port in Charleston, South Carolina. For this cruise, the ship carried a complement of 5-

7 officers, 20 civilian crew members, and up to 34 scientists. The complement was responsible for operating and navigating the ship, conducting scientific research, and supporting personnel through equipment maintenance, food, cleaning and other administrative services. Classroom@Sea participants were primarily NOAA Corps officers with specialized assistance being provided by scientists and crew members when needed.

Figure 3. The NOAA Ship RONALD H. BROWN.

The primary point of contact for Classroom@Sea was the ship's Medical Officer, with additional support provided by the Captain, the Field Operations Officer, and the Navigation Officer. All participants were volunteers who were interested in being involved in the project.

The Ridgemont Academy

The Ridgemont Academy (the Academy) was a Kindergarten through 8th Grade private school located in the Pacific Northwest. The school was developed to provide an appropriate learning environment for gifted students, particularly those with highly developed spatial problem solving abilities. Students attending this school come from a wide range of economic and demographic backgrounds as many students attend the school on scholarship.

The school was based on a strong Piagetian philosophy believing that these students learn best through hands-on activities and with guidance from expert teachers. According to Piaget, knowledge is not given, but rather constructed by the student through guided activities (Ginsburg and Opper, 1988). Students at the Academy participated in a wide variety of academic and non-academic activities. The

students involved in Classroom@Sea simultaneously participated in activities such as harp lessons, piano lessons, chess club, Karate, skiing, horseback riding, and ultimate Frisbee, to name a few. Other school highlights were the annual Science Fair, Friday ski trips throughout the winter, field trips to plays and museums, and even a trip out of the country for the eighth graders. The Academy tried to create an environment that supports the overall development of students.

The school had a dedicated technology lab supported by a highly qualified technology teacher, Ms. Simpson. Ms. Simpson had over 15 years experience teaching technology at the school, and had a very clear vision, and strong dedication to her program and students. Ms. Simpson based her curriculum from constructivist learning theory, believing technology should be used as a tool to support students' learning. Specifically, she believed technology should be used to help students construct things they could not otherwise construct, or communicate with people they could not otherwise communicate with. The lab was outfitted so that each student had their own computer while in the lab. All students had e-mail addresses, most typically through Yahoo! or Microsoft hotmail and were proficient at surfing the web and using a variety of software programs. The technology lab was also equipped with a scanner, color printer, and digital camera.

The school science program was also strongly based on the Piagetian philosophy. Student learning was supported primarily through well-designed hands-on activities and classroom discussions with guidance provided by teachers. There were no textbooks for students in the science classroom. For the most part, there were no written materials at all. In addition, there were no computers available to students while in science class. The reason for this was the school believed students should understand scientific concepts by first mastering concrete physical skills before working with the abstract features represented by computers. This was a kind of "do-it-yourself" approach - expecting longhand calculations before introducing a calculator.

The science teacher, Mr. Garrison, was an expert marine ecologist with a Master's of Science degree in marine science from the University of California at Santa Cruz. In addition, he was a first year teacher with no formal education or experience

teaching science to children. Throughout Classroom@Sea, Mr. Garrison endeavored to understand his learners, and manage his classroom, dilemmas faced by many first year teachers (Grossman, 1990).

University of Washington

A third institution was involved in the Classroom@Sea project. The University of Washington served as the research institution supporting Classroom@Sea. In June 1998, Dr. Leslie Herrenkohl was awarded money through the Royalty Research Fund to more formally develop Classroom@Sea learning activities, as well as a plan for studying the learning community (Herrenkohl, 1998a).

Money from the Royalty Research Fund was intended to fund a project team composed of Dr. Herrenkohl, myself, and an expert teacher. Dr. Herrenkohl was an expert in classroom-based research using qualitative methodologies whose primary role was to conduct research in the classroom. I had experience in classrooms, qualitative research methodologies, technologies, and ocean science. The classroom teacher involved had significant content knowledge, but no experience teaching.

Ultimately, I took on the roles of researcher and teacher, developing activities and providing classroom and shipboard support, and Mr. Garrison served as the Classroom@Sea teacher. Because Mr. Garrison was a first year teacher, and just beginning to know how to help students develop understandings of concepts that he understood well, he needed additional support in the classroom. Throughout the project he experimented with the design of activities and assessments, and tried to develop his own style of teaching. Dr. Herrenkohl continued to oversee the project and support research efforts.

Educational Foundations of Classroom@Sea

Classroom@Sea was based on sound educational principals. The purpose of this section is to provide a brief introduction to the educational literature that served as the foundation to this project.

Learning is an ongoing activity that occurs all around us every day. It is a complex social process involving relationships with other people in communities of practice (Lave & Wenger, 1991). It is through human interaction and by utilizing the tools and symbols of a culture that learners gain skills for engaging in and becoming contributing members of a community.

The term "everyday learning" refers to this complex social process, and offers great value and utility for classrooms for two reasons. First, it encourages students to recognize the informal learning already occurring in their own homes, communities, and schools. And second, it allows students to experience school-based learning within a larger context, thereby supporting students to make connections between learning inside and outside of school.

Building on the notion of everyday learning, Brown, Collins, and Duguid (1989) have developed a model of cognitive apprenticeship in an effort to make classroom activities more authentic, or more like activities that occur outside the school institution. Their model encourages students to become involved in learning experiences that are situated in the existing social structures, tools and ordinary practices of real communities. The premise is that students continually construct knowledge and skills by participating in collaborative problem-solving activities within the community.

According to McLellan (1996), technology has an increasingly important role today in everyday learning.

> Technology-related skills are increasingly central to learning in an age when human lives are immersed in electronic technologies…[similarly] technology has become central to everyday learning because it expands the power and flexibility of the resources that can be utilized to support the various components of learning that is situated in practice (p. 12).

Recent technological advances have had a profound impact on education. The fields of educational technology and instructional design recognize the collaborative and the sociocultural nature of learning. These fields are developing approaches to utilize and apply constructivism, situated learning and everyday learning into the classroom.

Unfortunately, little is known about how best to provide support, or even create possibilities for situated learning that uses these technologies in the classroom. Schlager, Poirier, and Means (1996) illustrate one piece of this dilemma.

> With the coming of the national information infrastructure, powerful multimedia links between classrooms and the world outside will make the participation of domain experts from a distance technically and economically possible. However, the technical ability to provide a distributed environment does not translate directly into distributed learning. To make effective use of this new capability, we must understand the nature of learning in a distributed environment. To date, however, little has been done to understand or elucidate the form(s) that the participation of outside experts should take, how to support it, or its implications for structuring education (p. 243).

Classroom@Sea was developed to provide insight into the links between instructional design and sociocultural perspectives of learning, and how to best provide support for the complex experiences being created across institutions. This was of particular interest to Classroom@Sea because it allowed me to address the problems schools have in taking advantage of learning opportunities afforded by technologies. Classroom@Sea pursued the development of a web-based learning community made up of two very different and very distant groups of people - officers, scientists and crew aboard the NOAA research vessel RON BROWN as it traveled throughout the equatorial Pacific, and students and teachers at The Ridgemont Academy in the Pacific Northwest. Classroom@Sea attempted to open up the everyday world of people aboard an ocean going research vessel with students in a classroom by providing the technological tools necessary for doing local and distant ocean science activities. It was a step toward connecting two different institutions utilizing on-line technologies to support sociocultural learning.

The purpose of Classroom@Sea was to create an on-line learning community where students could learn to do ocean science with guidance from scientists, officers, and crew aboard an operating research vessel. The analysis of the data collected from Classroom@Sea focused on all participants (e.g., teachers, students, scientists, officers, crew) including their perspectives of teaching and learning, their skills in using technologies, and their roles within their respective institutions. The analysis was not

solely focused on what students learned or did not learn from participating in Classroom@Sea.

Through conducting this project and analyzing the data, I learned that while technologies can connect the everyday worlds of two different and distant groups of people, the institutions and perspectives of participants impact the development of activities, and the quality of participants' communication and engagement.

Classroom@Sea Activities

Classroom@Sea consisted of a number of activities developed to engage participants in sharing ideas and information about ocean science. While these activities were centered on the topic of ocean science they each involved one or more of the following elements:

1. Science
2. Technology
3. Communication between ship and classroom

Activities involving science were designed to focus on a specific concept or concepts associated with ocean science and with the real people interested in those science concepts. For example, students built miniature CTD (Conductivity, Temperature, Depth) probes in the science laboratory that were similar to some of the procedures being used by the ship in order to better understand the conductivity, temperature and depth of different water bodies.

Activities involving technology were designed to encourage participants to gain skills in using technologies for gathering, representing and sharing information. Examples of technology activities aboard the ship included capturing and digitizing video and images, conducting research, and analyzing data. These technologies were similar to those being used by webmasters and scientists at sea and on shore. In the classroom, students also used software and programming languages to construct their own ocean science web pages.

Activities focusing on communication among participants were specifically designed to make connections between ship and shore - to be used as tools for building

relationships among Classroom@Sea participants. The most obvious of these activities were the live satellite broadcasts and the message board where e-mail transmissions were posted.

Three activities emerged as the primary activities for Classroom@Sea. These activities emerged because of the interests and expertise of the participants, and the time and resources available. These three activities are:

1. Styrofoam cup activity
2. Web site design activity
3. CTD probe activity

The Styrofoam cup activity was developed by the Captain of the RON BROWN in conjunction with the other officers, myself and Dr. Herrenkohl. The activity was intended as a means for students and shipboard participants to introduce themselves to one another, and for students to learn about a common scientific activity occurring aboard ship. The activity involved students writing on Styrofoam cups something they knew and didn't know about ocean science, and sending the cups to the ship.

Figure 4. Students' Styrofoam cups on board the RON BROWN.

The ship attached the cups to a CTD instrument and then submerged them to a depth in the ocean. Upon returning to the surface the cups appeared "crushed". The entire experiment was documented on video, and shared with students via the Classroom@Sea web site. Students used the Classroom@Sea electronic message board to send and receive questions and images. In addition, a live video broadcast was conducted at the conclusion of the activity so that

shipboard participants could show students their cups, and could answer some of the questions the students had written.

The Web site design activity was developed by me with assistance from Ms. Simpson, and the Classroom@Sea webmaster. For this activity, students selected an

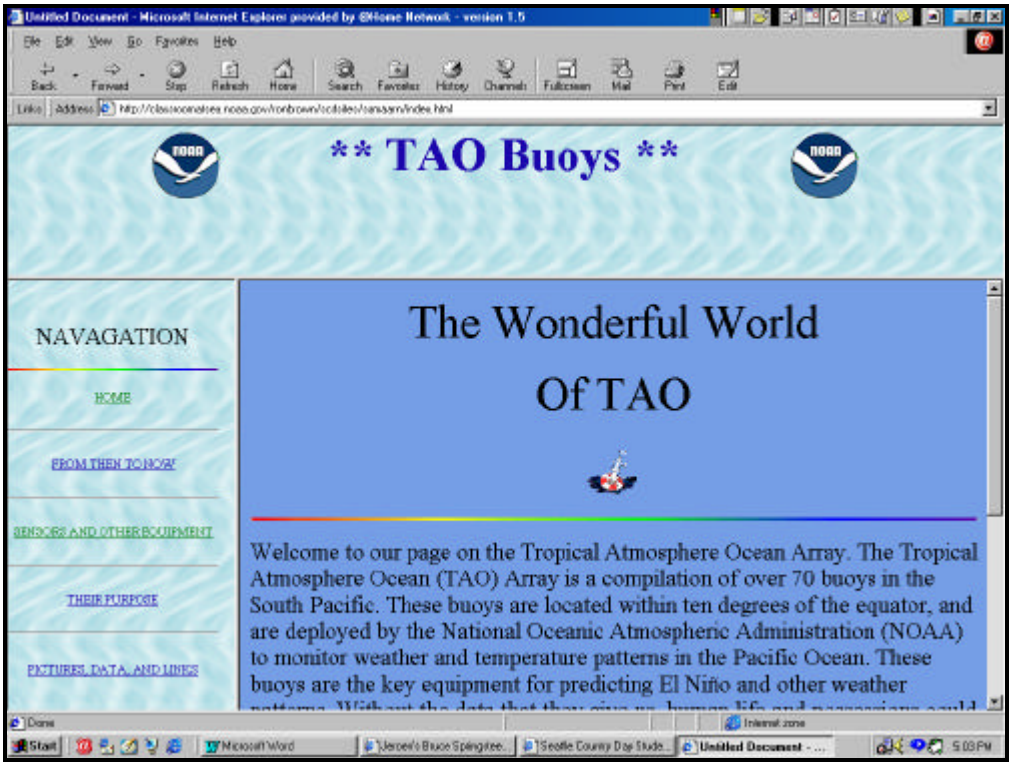

Figure 5. Tao Buoy web site produced by students in Classroom@Sea.

ocean science topic of their choosing, identified a target audience and designed and constructed a web site. Several students chose topics directly relating to the activities on board ship, and corresponded with shipboard participants to obtain information and ideas for their sites. See the Tao Buoy web site in Figure 5. Remaining students communicated with other individuals and institutions to obtain information and images for their site.

The CTD probe activity was developed by Mr. Garrison, the 7th grade science teacher. The activity encouraged students to conduct an experiment similar to one of the scientific experiments aboard the ship. A CTD sampling device is a common piece of equipment on board NOAA research vessels. This device is used to collect water

samples at different depths in order to measure conductivity, temperature and depth. Mr. Garrison developed an activity in which students constructed their own CTD probes in the classroom in order to test the conductivity of different types of water solutions. The purpose of the activity was to help students apply the knowledge they had gained while studying corrosion currents earlier in the school year to learn about the attributes of different water bodies. They were charged with choosing the metals necessary for constructing a device that would measure electrical currents in water. Students had to devise a plan for insulating the wires from corrosion, while maintaining the sensitivity of the apparatus to read measurements accurately. In addition, their resulting instrument had to be durable. Once students had their instruments operational they attached digital thermometers, and created depth marks, thereby constructing their own CTD. Students had mock oceans set up in tubs of water with different salinity concentrations, and temperatures, which they could measure.

Classroom@Sea Research

Introduction to Design Experiments

Classroom@Sea was a design experiment intended to create a learning community in which scientists and crew aboard a research vessel and students in the classroom investigated the oceans together. A design experiment involves "engineer(ing) innovative educational environments and simultaneously conduct(ing) experimental studies of those innovations" (Brown, 1992, p. 142). Design experiments have the following characteristics. They:

- address learning programs involving important subject matter;
- are usually mediated by innovative technology;
- are embedded in everyday social contexts which are often classrooms;
- can serve as models for broader reform; and
- contribute simultaneously to fundamental scientific understanding of learning and education; (Hsi, 1998).

Clasroom@Sea contained the general characteristics described above. However, it failed to meet some specific assumptions associated with design experiments. First, in conducting Classroom@Sea, it was not possible to "orchestrate all aspects of daily

life in the classroom" (Brown, 1992, p. 142). The "classroom" for this project included the science and technology labs of The Ridgemont Academy (the Academy) and the NOAA Ship RON BROWN as it traveled the Pacific Ocean. The boundaries and dynamics of the Classroom@Sea "classroom" prohibited me, the researcher, from orchestrating activities. Instead, much of the design and implementation of activities was developed, implemented, and modified by the participants themselves, while in progress, due to technological difficulties, changes in weather, or changes in scheduling. Second, Brown (1992) indicates the classroom participating in a design experiment must function smoothly as a learning environment prior to the researchers' involvement. The Classroom@Sea classroom was composed of students at the Academy and participants aboard the RON BROWN. Prior to the development of Classroom@Sea this extended classroom or learning community did not exist. In addition, the teacher in charge of the science classroom at the Academy was a new teacher with no prior teaching experience. Similarly, participants aboard the RON BROWN, while expert scientists and crew, had varying degrees of teaching experience, and no experiences teaching students via the web. Given this lack of history, it was not possible to determine ahead of time if the classroom was indeed functioning smoothly prior to introducing Classroom@Sea. One of the purposes of this study was, in fact, to determine if such a classroom could function smoothly.

Given this, Classroom@Sea evolved as a design experiment lacking significant control. Brown (1992) describes design experiments as "a trade-off between experimental control and richness and reality" (p. 152). In this statement, Brown (1992) considers a spectrum of control ranging from experimental control to control in design experiments. The reality of implementing the Classroom@Sea design experiment was recognizing not only a lack of experimental control, but also limited control over the activities of the design experiment. The reality were some significant trade-off's between not conducting Classroom@Sea at all, or conducting it using a less rigorous structure that accommodated the schedules of the institutions, the existing skills of the participants, and the available technologies. As a result, the research project stood somewhere between a design experiment and an ethnography. My role in this effort was

both as a developer and supporter of the learning community, as well as an observer and researcher.

Research Questions

Following was the overarching research question for this project.

What contributed to and impeded the "sense of community" among Classroom@Sea participants?

This primary research question helped guide data collection and analysis, but was broken down further into 3 specific questions that became the focus of this project. These questions are:

1. What institutional challenges and opportunities exist for Classroom@Sea? How will these challenges and opportunities impact participation in the learning community?

2. What are teachers, students, and NOAA personnel's perspectives of teaching and learning, and utilizing technologies? How do these perspectives impact their participation in the learning community?

3. What are the affordances and constraints of the technologies? How do these impact participation in the learning community?

Classroom@Sea Findings

Within this community of learning, I set out to better understand the roles of participants, and how best to provide support to them so they could investigate and communicate about ocean science together.

What I have learned in creating, implementing, and now reflecting on Classroom@Sea is that there exist many possibilities for making connections between students in school and adults outside of school. At the same time, there are specific challenges and opportunities associated with the institutions involved, and technologies used, as well as the perspectives of participants that must be incorporated into a community in order for the community to be effective.

In order to make sense of the data and findings of Classroom@Sea it is useful to consider an approach described by Wertsch (1998). Wertsch (1998) states,

> The task of a sociocultural approach is to explicate the relationships between human action, on the one hand, and the cultural, institutional and historical context in which this action occurs on the other" (p. 24).

Each of the communities, the Academy and the RON BROWN, came to Classroom@Sea with very different cultural, institutional, and historical contexts. Each institution was designed to serve very different purposes. Yet, through this project, we attempted to bring them together to form a community for teaching and learning about ocean science. The formation of a Classroom@Sea community depended on the extent to which participants aboard the ship and in the classroom were willing and able to use the available technologies, and to participate in face-to-face meetings to engage in activities. Given this, the overall question remains: Was there a sense of community in Classroom@Sea?

Important Lessons Learned

The analysis of Classroom@Sea data revealed several interesting findings about developing and implementing this on-line learning community. Below, I have summarized what I have learned as it relates to each of the three research questions asked at the outset of this study. My understanding has emerged from the data collected and analyzed for this project, and my reflections of the project overall.

Question 1

What institutional challenges and opportunities existed for Classroom@Sea?

Institutional Opportunities

RON BROWN	The Ridgemont Academy
▪ The ship was involved in interesting oceanographic work. ▪ The ship had technological capabilities to do live audio and video transmissions. ▪ The ship's personnel were willing and interested in participating.	▪ The school had a well-equipped technology lab. ▪ The science teacher was experienced in doing oceanographic field work. ▪ The technology teacher had significant experience, and was interested in the project.

Institutional Challenges

RON BROWN	The Ridgemont Academy
▪ While innovative technologies were available, they did not always function properly, and skilled personnel and equipment were not always available to make repairs. ▪ The ship had a strict scientific schedule that changed due to changing weather conditions or scientific protocol.	▪ The school science program was based on a Piagetian discovery philosophy that discouraged technology use in the science classroom. ▪ The Science teacher was an expert in ocean science, but had no prior teaching experience or pedagogical training. ▪ Classroom@Sea had to compete with other activities ongoing at the school such as the School Science Fair

How did these challenges and opportunities impact participation in the learning community?

The institutions in Classroom@Sea, the NOAA Ship RON BROWN and The Ridgemont Academy were very different and distant from one another. Each institution was designed with a specific purpose in mind. And, each institution posed challenges and opportunities for participating in Classroom@Sea.

Classroom@Sea was a demonstration project, and by default was not a high priority for either institution. Classroom@Sea often had to be modified to accommodate the changing schedules of the institutions. In addition, because of the differences in the institutions and their missions it was difficult to establish tangible expectations for each group of participants. Similarly, it was difficult to develop roles and responsibilities for participants and ensure accountability. However, each institution also offered a variety of resources, and participant experiences that contributed to the excitement of the project and the possibilities for doing ocean science.

Question 2

What are teachers, students, and NOAA personnel's perspectives of teaching and learning?
Examples of participants' perspectives of teaching and learning
Science Teacher Mr. Garrison was developing his perspectives of teaching and learning in the classroom. Throughout Classroom@Sea he tried to put into practice the philosophy of the Academy and his knowledge of scientific concepts, while managing and understanding the students in his classroom. The impacted his ability to serve as an effective guide to his students in Classroom@Sea.
Captain of the Ship The Captain had a self-proclaimed linear perspective of teaching and learning. He contributed to the development of the Styrofoam cup activity, viewing it from an operational stand-point of how it could be carried out step by step. With this perspective the tasks of the activity were accomplished, but the Captain had difficulty communicating with the students, such as engaging students during the live satellite broadcast.
Technology Teacher Ms. Simpson based her curriculum on constructivist learning theory, believing technology should be used as a tool to support students learning. Specifically, she believed technology should be used to help students construct things they could not otherwise construct, or communicate with people they could not otherwise communicate with. This was directly in line with the overall purpose of Classroom@Sea.
How do these perspectives impact their participation in the learning community? Participants each had their own perspectives of teaching and learning. Many participants, particularly those aboard ship were not consciously aware of their perspectives or how their perspectives might impact their communication or engagement in activities within the learning community. These perspectives have been shaped, in part, by the institutions they belong to, and in part, by participants' own life experiences. Participants' perspectives influenced how they developed and engaged in activities within the community, and ultimately how they communicated with other participants. Understanding perspectives of teaching and learning and using technologies can be a useful way to identify key participants and their potential roles within a community. It can also serve as a means for participants to get to know one another in terms of past experiences, future goals, preferred methods of interaction, etc. Finally, it can help supporters outside the community know what kinds of training or support might be useful. Training and support could help develop communication strategies, use technologies more effectively, better design activities, or provide better mechanisms for participating in activities.

Question 3

What were the affordances and constraints of the technologies?

Affordances of Technologies	
RON BROWN ▪ The ship had satellite technologies that allowed for real-time video and audio transmission from the ship to the students in the classroom.	**The Ridgemont Academy** ▪ The school had a well-equipped technology lab that had functioning equipment, and an expert teacher available to facilitate equipment use.
Constraints of Technologies	
RON BROWN ▪ The satellite technologies were also a constraint because they were not yet reliable. ▪ No one on board had a lot of experience working with the new technologies or experience in troubleshooting problems when they arose.	**The Ridgemont Academy** ▪ The lab was a constraint in that it was the only place students had access to computers, and to the Classroom@Sea web site. ▪ Students had computer class twice per week for 45 minutes each, and limited access to the computers at other times during the day.

How did these impact participation in the learning community?

The computer and satellite technologies available to both students and shipboard personnel are what made Classroom@Sea possible. However, the technologies also had affordances and constraints that impacted the Classroom@Sea learning community.

It has been my experience that technologies from the simplest to the most sophisticated serve as both affordances and constraints. The challenge is to maximize the affordances and minimize the constraints. For Classroom@Sea, this means having computers accessible in the science classroom for student communication and information gathering/sharing, and having a computer lab with dedicated time for student projects. Further it means having adequate technical support available so equipment operates, and/or to provide assistance to students and teachers. Similar requirements are needed for ship board personnel. There needs to be equipment available for them to participate in activities, and there needs to be people who know how to use it. In addition, given the ship is out at sea, there needs to be equipment and expertise available on board ship for repairs when needed.

There were many lessons learned from the development, implementation, and reflection of the Classroom@Sea project. However, the predominant question still remains to be answered.

What contributed to and impeded the "sense of community" among Classroom@Sea participants?

A "sense of community" refers to participants' willingness and ability to communicate with one another and engage in Classroom@Sea activities. By willingness I mean participants' interest in being involved. Shipboard participants, and students and teachers were all interested and agreed to be involved by their own choice. By ability, I mean participants' skills in using web based technologies for sharing information and ideas. All participants on board the ship were capable of using e-mail and therefore had the ability to communicate with students. All students were skilled in using e-mail and the web to send and receive questions and answers with shipboard participants. Given this, to have a "sense of community" among participants in Classroom@Sea, I would have expected on-going communication between the ship and school that was unsolicited by me as the coordinator, researcher and a teacher for the project. This was not the case. There was limited communication between shipboard participants and students throughout Classroom@Sea.

At the outset of Classroom@Sea we were well aware of the potential impacts of participants' perspectives of teaching and learning. In addition, we were aware of the potential affordances and constraints of technology. Further, we recognized that participants' perspectives, and the technologies were embedded in institutions, and therefore, institutions would influence the Classroom@Sea community.

Given the interest of the participants, and their dedication and motivation for participating in Classroom@Sea, it would seem that we should have easily created a "sense of community". Participants on board the ship volunteered to become involved and students thought the idea of participating in a project outside of school was a fun

way to spend time in science class. Yet with all of this we still did not create a sense of community among the participants.

The value in this finding is that beyond the good intentions of the individuals, there needed to be commitment from the institutions. In other words, the institutions involved needed to take ownership of the project and provide institutional incentives and support to the participants.

In order to create a sense of community for Classroom@Sea, the Academy would need to modify its philosophy, integrating computers into their science classroom. The curriculum would have to be more closely tied to the work aboard ship, and should involve other school disciplines such as language arts or social studies. Ideally, the teachers would work more closely with the ship to understand the ship's upcoming work, and would then modify their curriculum to embrace the real activities occurring on board. In addition, the school and school science program would have to make Classroom@Sea a priority, so as not to compete with other activities.

Adjustments should be made on board the ship as well. Classroom@Sea would need to be recognized as a meaningful program complementing the work already on-going aboard ship. The RON BROWN did have an officer dedicated to Classroom@Sea, who proved invaluable for maintaining the project on board the ship. However, Classroom@Sea would need to become a more visible and integral part of what shipboard personnel do. A more formalized program could solicit and provide incentives and training for project participants, encouraging other members of the scientific party, officers, and crew to become involved.

Re-Envisioning Classroom@Sea

Classroom@Sea was created as a demonstration project. The intent was to create an experience that encouraged participants to engage in activities and communicate with one another about ocean science. The collection and analysis of data for this demonstration focused on all participants, rather than focusing specifically on what students learned from the experience. The reason for this was primarily due to limitations in time and scheduling, and a lack of support staff. With this in mind, a next

step in re-envisioning Classroom@Sea would be to have student learning as the focus of the study.

In order to do this the same or a different ship could be involved, as long as the ship had the technology available for live satellite broadcasts, and scientists, officers and crew who were interested in participating. In addition, I suggest involving a different school and classroom. I suggest this for 3 reasons. First, I think it would be useful to work with a public school and the challenges and opportunities associated with that type of institution. Second, I think it would be useful to work with a more experienced science teacher. And, third, it is not possible to recreate the school/student/ teacher combination originally involved in this project.

In addition, I suggest several specific recommendations to follow both prior to and during implementation. These strategies would help in identifying institutional candidates and individual participants who want and are capable of being involved in the community. These suggestions are described below.

Prior to launching Classroom@Sea

▪ Clearly identify the challenges and opportunities of the institutions. Specifically, identify their philosophies for teaching and learning, and current and future education programs that either directly relate to or conflict with Classroom@Sea. Identify the tools and resources available to participants, and the time available for scheduling participation in the community.
▪ Understand participants' perspectives of teaching and learning, and using technologies. This information would be useful for designing activities, introducing participants to one another, developing communication strategies, and identifying and supporting key participant roles within the community.
▪ Assess the quantity, quality and proximity of available technologies, and technical support people. Understanding the nature and proximity of the technologies and support people would help in designing activities and support, and help in creating realistic expectations for the community.

Implementing Classroom@Sea

- Provide "too much" structure and support during the initial phases of implementation. Initial activities should be well though out, with clear lesson plans and objectives. The purpose in doing this is so that participants can practice using the tools and technologies, and can practice communicating with one another. Structured activities in the early stages of the learning community allow participants to focus on getting to know one another, and learning to use the tools and resources available to them in the community. Once participants have gotten to know one another, and have practiced using the tools and resources available to them, activities should be introduced that allow participants to express their own interests, and meet their own needs.
- Later activities should focus on "the real work" of doing ocean science. In the case of Classroom@Sea, it would be ideal if these later activities served a real need for the ship such as having students plot a navigation course, or working with scientists to design and carry out an experiment. In addition, it would be ideal if students developed projects for shipboard personnel that went beyond answering questions. An example of this might be building the miniature CTD probes as we attempted to do in this study.

The design discussed above would provide opportunity for focusing on student learning. Students would have time to practice using the tools and resources available to them, and would have support in the initial stages of the community in order to feel comfortable and confident in working with other participants.

Final Thoughts

In conclusion, building on-line learning communities composed of two different and distant groups of people together - like Classroom@Sea - is not only about bringing people together. It is also about bringing together institutions. The culture and histories of the institutions, and their impacts on participants must be incorporated into the development of the community. This is not to say that institutions are deterministically working on people, but that institutions need to be taken into consideration when doing projects across institutional boundaries. Beyond the good intentions of participants, there needs to be commitment from the institutions. Institutions are not likely to change significantly in order to participate in an on-line learning community. However, recognizing the culture and history of the institutions, and what types of challenges and opportunities they bring to the community can help mediate difficulties and create a more supportive and effective environment for learning.

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